Fig. 5 shows another embodiment of the reaction apparatus.

DETAILED DESCRIPTION

The catalytic reaction apparatus seen in Fig. 1 depicts a preferred embodiment of the present invention. The apparatus comprises a combustion chamber 4, a convection chamber 17 extending into chamber 4, and a reaction chamber 16. The combustion chamber 4 is defined by the zone enclosed or surrounded by refractory insulation 6. The reaction chamber 16 is defined by the volume enclosed by tubular reactor conduit 1. The tubular reactor conduit 1 is formed in a U-tube or hairpin configuration having parallel upright legs 1a and 1b, and a U-shaped bend 1c, and can be removed from the combustion chamber upon removal of a top flange 18. Leg 1b of the tubular reactor conduit 1 passes concentrically through the convection chamber 17 defined by the space enclosed between the convection conduit 10 and the leg 1b of the tubular reactor conduit 1. The reaction chamber including 1a, 1b, and 1c is packed with catalyst from the inlet fitting or means 2, where reactants enter, to the outlet port or

means 3 where products exit. Convection conduit opens at 13 to chamber 4, and discharges at 11.

An axially extending, vertically disposed radiant burner 7 is supported by a burner gas conduit 12 that conveys a mixture of fuel and oxidant from an inlet means 8 to the radiant burner. In this embodiment, the radiant burner 7 comprises a gas permeable metal fiber zone 14 and a non-permeable zone 16. Fuel and oxidant pass through the permeable metal fiber zone 14 where they are ignited on the surface thereby combusting and releasing heat to form an incandescent zone that radiates energy outward in an arc 15. The arc angles γ_1 and γ_2 of 14 and 16 are such (angle of 14 is between 45° and 180°) that the radiating pattern maximizes the flux of radiant energy to the surfaces of the tubular reactor legs 1a and 1b, and also U-bend 1c, while minimizing the flux of radiant energy to the internal wall 19 of combustion chamber 4. Fuel and oxidant are initially ignited on the surface of the permeable metal fiber zone 14 using an igniter 9. Once ignited, the combustion reaction on the surface of the metal fiber zone 14 facing 1a and 1b is self-sustaining.

The radiant arc angle of 14 is selected so that the direct radiant flux from the burner that bisects the projected surface of the reaction chamber

tube wall is a minimum of 50% of the total radiation flux that emanates from the active radiant burner surface. As an illustration of the condition, Fig. 2 depicts a geometric representation of the preferred embodiment of the present invention. The active radiant zone 14 emits radiation along a line of sight defined by a radiant arc 15 that impinges on the reaction chamber conduit legs 1a and 1b and the inner surface 19 of the combustion chamber. The emitted radiation is bisected by hypothetical plane 50 passing through the centerline of the U-tube reaction chamber. The projected area of the reaction chamber surfaces per unit tube length receiving direct radiation from the burner within the controlled radiant arc is given by a + a = 2a, where ''a'' is the outer diameter of each leg. The total radiation within the arc 15 is given by c + c + a + a + b = 2c + 2a + b. The dimensions ''a'', ''b'' and ''c'' are as shown. In the preferred embodiment of the present invention, the ratio of 2a divided by 2c + 2a + b is typically greater than 0.5 or 50%.

In the present invention, the radiant burner combustion intensity is controlled in the range of 150,000 btu/ft^2/h and 350,000 btu/ft^2/h wherein the combustion intensity is defined as the higher heating value of the fuel combusted divided by the permeable